What can we learn from angle-resolved photoemission spectroscopy on the dynamics of the charge carriers in high-T_c superconductors

J. Fink

IFW Dresden, P.O. Box 270116, Dresden, Germany

Using angular-resolved photoemission (ARPES) in the traditional way, the Fermi surface and the bilayer splitting could be determined in the high-T_c superconductor $Bi_2Sr_2CaCu_2O_{8+\delta}$ as function of the hole concentration. Thus the independent particle bandstructure, could be derived. On the other hand, modern high-resolution ARPES is able to provide further important information on the electronic structure of high-T_c superconductors, such as the renormalized effective mass and the scattering rates of the charge carriers. Both quantities which determine the complex self-energy function and thus the many-body properties have been found to be strongly dependent on the hole concentration, the temperature, and the location of the Fermi surface. In underdoped samples for $T < T_c$ near $(\pi, 0)$ a huge renormalization of the mass of the charge carriers has been detected while above T_c both along (π, π) and particularly near $(\pi, 0)$ in over- and underdoped samples the renormalization is considerably weaker. The results are discussed in terms of an interaction of the charge carriers with bosonic excitations. We have strong indications that these excitations which possibly are also related to a pairing of the holes in the superconducting state are spinfluctuations. Another important result is related to the existence or non-existence of a new phase in the pseudogap region having a hidden order with time-reversal symmetry breaking. Contrary to previous studies, for superstructure-free $(Bi,Pb)_2Sr_2CaCu_2O_{8+\delta}$ samples we could not detect the new phase using ARPES with circularly polarized photons. On the other hand a detailed comparison between theory and experiment of the characteristic change of the quasiparticle dispersion in crossing T_c indicates that the pseudo gap is due to phase fluctuations of the superconducting order parameter.